

EXHIBIT A

U.S. Patent No. 8,870,410

Claims

10. An optics panel for use in a light emitting diode (LED) lighting assembly for illuminating a billboard that has a display surface extending between outer edges of the billboard, the optics panel comprising:

a plurality of LEDs directed toward the display surface; and

a plurality of lenses, wherein each lens is disposed over only one associated LED and is configured to direct light from that LED toward the display surface, such that the light from each lens is directed across the entire display surface of the billboard, wherein the light intensity from each lens is **substantially uniform** across the entire display surface.

12. The panel of claim 10, wherein areas beyond edges of the display surface receive **substantially no illumination** from each of the LEDs.

27. A method of illuminating a billboard that has a display surface extending between outer edges of the billboard using a light emitting diode (LED) lighting assembly, the LED lighting assembly comprising a plurality of LEDs and a plurality of lenses, wherein each lens is disposed over only one associated LED, the method comprising:

directing a plurality of LEDs toward the display surface; and

illuminating the display by directing light from each LED toward the display surface, such that the light from each lens is directed across the entire display surface of the billboard, wherein the light intensity from each lens is **substantially uniform** across the entire display surface.

28. The method of claim 27, wherein **substantially no illumination** is directed towards areas beyond edges of the display surface from each of the LEDs.

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2. The panel of claim 1, wherein the areas beyond the edges of the display surface receive substantially no illumination from each of the LEDs.
16. An optics panel for use in a light emitting diode (LED) lighting assembly, the optics panel comprising: a plurality of LEDs directed toward the display surface; and a plurality of optical elements, each optical element disposed over only one associated LED and configured to direct light from that LED toward a display surface external to the optics panel, such that the light from each LED is directed across the entire display surface so that, for each LED, a ratio of the average illumination from that LED across the entire display surface to the minimum illumination from that LED at any point on the display surface is 3:1, and wherein areas beyond edges of the display surface receive minimal amount of illumination from that LED.
17. The panel of claim 16, wherein the areas beyond the edges of the display surface receive substantially no illumination from each of the LEDs.

U.S. Patent No. 9,212,803

Claims

1. An apparatus comprising a lighting assembly for illumination of a billboard, the lighting assembly comprising:
a plurality of means for emitting light;
means for mounting the plurality of means for emitting light;
means for conducting heat thermally coupled to a first major surface of the means for mounting the plurality of means for emitting light, the means for conducting heat including a plurality of fins extending away from the means for mounting a plurality of means for emitting light,
wherein the plurality of means for emitting light is attached to a second major surface of the means for mounting a plurality of means for emitting light, wherein the second major surface is opposite the first major surface, wherein the plurality of means for emitting light is arranged in two rows and each row includes more than one of the plurality of means for emitting light; and
a plurality of **means for directing light** that all have substantially the same structure, wherein each **means for directing light** of the plurality of **means for directing light** is proximate one associated means for emitting light of the plurality of means for emitting light such that light from each means for emitting light of the plurality of means for emitting light is configured to exit towards the billboard from an associated **means for directing light**, wherein each of the associated **means for directing light** comprises
a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side,
a first element disposed at the first side,
a second element disposed at the second side, and
a third element disposed at the third side, wherein the third element extends beyond the first element and the second element in a direction away from the means for emitting light,
wherein, in the direction away from the associated means for emitting light, the first element includes a first outer surface protruding outwards and a first inner surface having a concave-like curvature and the second element includes a second outer surface protruding outwards and a second inner surface having a concave-like curvature, the second outer surface being different than the first outer surface and the second inner surface being different than the first inner surface,
wherein the first outer surface joins with the second outer surface at a joint having an outer surface different from the first and the second outer surfaces, wherein the first inner surface joins with the second inner surface at the joint having an inner surface different from the first and the second inner surfaces
3. An apparatus comprising a lighting assembly for illumination of an area, the assembly comprising:
a plurality of light emitting diodes (LEDs); and
a plurality of optical elements, wherein each optical element of the plurality of optical elements is proximate an associated LED of the plurality of LEDs, wherein each **optical element** of the plurality of optical elements **comprises**
a first side, a second side opposite the first side, and a third side perpendicular to the first

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side and the second side,
a first element disposed at the first side,
a second element disposed at the second side, **and**
a third element disposed at the third side,
 wherein the third element extends beyond the first element and the second element in a direction away from the associated LED of the plurality of LEDs,
 wherein, in the direction away from the associated LED, the first element includes a first convex outer surface and the second element includes a second convex outer surface different than the first outer convex surface, and
 wherein the first convex outer surface has a first peak at a first distance from a point on the associated LED and the second convex outer surface has a second peak spaced from the first peak, the second peak being at a second distance from the point on the associated LED; and
 wherein the first convex outer surface and the second convex outer surface connect at a connection region that is at a third distance from the point on the associated LED, wherein the third distance is shorter than the first distance as well as the second distance.

12. A billboard comprising:
 a support structure;
 a display surface mounted on the support structure; and
 a lighting assembly coupled to a structural member of the billboard at a position angled with respect to the display surface, wherein the lighting assembly comprises a plurality of light emitting diodes (LEDs) and a plurality of optical elements,
 wherein each optical element of the plurality of optical elements is proximate an associated LED of the plurality of LEDs,
 wherein each **optical element** of the plurality of optical elements **comprises**
 a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side,
 a first element comprising a first convex-shaped surface disposed at the first side,
 a second element comprising a second convex-shaped surface disposed at the second side, wherein the second convex-shaped surface intersects with the first convex-shaped surface at an acute angle in a region between the first element and the second element, wherein the light from the associated LED exits the optical element through the first and the second convex-shaped surfaces, **and**
 a third element disposed at the third side, wherein the third element extends beyond the first element and the second element in a direction away from the associated LED.

16. The billboard of claim 15, further comprising
 a second lighting assembly located to illuminate a second portion of the display surface, the second lighting assembly comprising a plurality of LEDs and a plurality of optical elements, each optical element of the plurality of optical elements of the second lighting assembly being disposed over an associated LED of the plurality of optical elements of

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the second lighting assembly, wherein each optical element of the plurality of optical elements comprises a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side, a first element disposed at the first side, a second element disposed at the second side, and a third element disposed at the third side, wherein the third element extends beyond the first element and the second element in a direction away from the LED of the plurality of LEDs of the second lighting assembly;

wherein the second portion of the display surface comprises a second half of the display surface;

wherein the display surface has a width of forty-eight feet; and

wherein the lighting assembly and the second lighting assembly are configured to generate sufficient **uniform illumination** so that all of the display surface can be illuminated using only the lighting assembly and the second lighting assembly.

U.S. Patent No. 9,234,642

Claims

1. A billboard comprising:
a support structure;
a display surface mounted on the support structure, the display surface having a width of forty-eight feet along an upper edge and a lower edge of the display surface and a height of fourteen feet along a left side edge and a right side edge of the display surface, the display surface comprising a first portion extending from the lower edge to the upper edge near the left side edge and a second portion extending from the lower edge to the upper edge near the right side edge, the first and second portions together extending from the left side edge to the right side edge;
a walkway attached to the support structure adjacent the lower edge of the display surface, wherein an uppermost surface of the walkway is vertically spaced at a distance lower than a lowermost portion of the display surface;
a first lighting assembly that includes a plurality of light emitting diodes (LEDs) and a plurality of optical elements, wherein each optical element is disposed over only one associated LED, the **optical elements each including a first portion, a second portion and a third portion** arranged to direct light toward the display surface so that each LED of the first lighting assembly can illuminate the first portion of the display surface, wherein all of the LEDs of the first lighting assembly are mounted in a single assembly attached to the walkway, the first lighting assembly including a first heat sink; and
a second lighting assembly that includes a plurality of LEDs and a plurality of optical elements, wherein each optical element is disposed over only one associated LED, the **optical elements each including a first portion, a second portion and a third portion** arranged to direct light toward the display surface so that each LED of the second lighting assembly can illuminate the second portion of the display surface, the first portion and the second portion comprising all of the display surface, wherein all of the LEDs of the second lighting assembly are mounted in a single assembly attached to the walkway, the second lighting assembly including a second heat sink, wherein all of the display surface can be illuminated using only the first lighting assembly and the second lighting assembly.

13. The billboard of claim 10, wherein the first lighting assembly is configured to **uniformly illuminate** the first area of the display surface, and wherein the second lighting assembly is configured to **uniformly illuminate** the second area of the display surface.

16. The billboard of claim 10, wherein each **optical element** of the plurality of optical elements of the first and the second lighting assemblies **comprises**:
a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side;
a first element comprising a first convex-shaped surface disposed at the first side;
a second element comprising a second convex-shaped surface disposed at the second side, wherein the second convex-shaped surface intersects with the first convex-shaped surface at an acute angle in a region between the first element and the second element, wherein the light from the associated LED exits the optical element through the first and the second convex-shaped surfaces; **and**

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<p>a third element disposed at the third side, wherein the third element extends beyond the first element and the second element in a direction away from the associated LED.</p>
<p>17. The billboard of claim 10, wherein each optical element of the plurality of optical elements of the first and the second lighting assemblies comprises: a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side; a first element disposed at the first side; a second element disposed at the second side; a third element disposed at the third side; wherein the third element extends beyond the first element and the second element in a direction away from the associated LED; wherein the first element includes a first outer surface and a first inner surface facing the associated LED and the second element includes a second outer surface and a second inner surface facing the associated LED; wherein the first inner surface is located at a first nearest distance from the associated LED and the second inner surface is located at a second nearest distance from the associated LED; and wherein the first inner surface and the second inner surface connect at a connection region that is at a third nearest distance from the associated LED, wherein the third nearest distance is shorter than either the first nearest distance or the second nearest distance.</p>
<p>21. The billboard of claim 18, wherein the optical elements of the first and the second lighting assemblies are arranged so that areas beyond edges of the display surface receive minimum illumination.</p>
<p>23. The billboard of claim 18, wherein each optical element of the plurality of optical elements of the first and the second lighting assemblies comprises: a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side; a first element comprising a first convex-shaped surface disposed at the first side; a second element comprising a second convex-shaped surface disposed at the second side, wherein the second convex-shaped surface intersects with the first convex-shaped surface at an acute angle in a region between the first element and the second element, wherein the light from the associated LED exits the optical element through the first and the second convex-shaped surfaces; and a third element disposed at the third side, wherein the third element extends beyond the first element and the second element in a direction away from the associated LED.</p>
<p>24. The billboard of claim 18, wherein each optical element of the plurality of optical elements of the first and the second lighting assemblies comprises: a first side, a second side opposite the first side, and a third side perpendicular to the first side and the second side; a first element disposed at the first side;</p>

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a second element disposed at the second side;
a third element disposed at the third side;
wherein the third element extends beyond the first element and the second element in a direction away from the associated LED;
wherein the first element includes a first outer surface and a first inner surface facing the associated LED and the second element includes a second outer surface and a second inner surface facing the associated LED;
wherein the first inner surface is located at a first nearest distance from the associated LED and the second inner surface is located at a second nearest distance from the associated LED;
and
wherein the first inner surface and the second inner surface connect at a connection region that is at a third nearest distance from the associated LED, wherein the third nearest distance is shorter than either the first nearest distance or the second nearest distance

U.S. Patent No. 9,349,307
Claims
<p>1. A billboard comprising: a support structure; a display surface mounted on the support structure, the display surface having visual media content displayed thereon, the visual media content comprising a picture and/or text, wherein the display surface has a width of forty-eight feet along an upper edge and a lower edge of the display surface and a height of fourteen feet along a left side edge and a right side edge of the display surface, the display surface comprising a first portion extending from the lower edge to the upper edge adjacent the left side edge and a second portion extending from the lower edge to the upper edge adjacent the right side edge, the first and second portions together extending from the left side edge to the right side edge; a walkway attached to the support structure adjacent the lower edge of the display surface, wherein an uppermost surface of the walkway is vertically spaced at a distance lower than the lower edge of the display surface; a first lighting assembly that includes a first plurality of light emitting diodes (LEDs) and a first plurality of optical elements, the first plurality of LEDs being thermally coupled to a first heat sink, wherein the LEDs of the first plurality of LEDs are arranged in a plurality of rows, each row including a plurality of LEDs mounted so that all of the LEDs of the first lighting assembly are arranged in a common orientation, and wherein each optical element of the first plurality of optical elements is disposed over only one associated LED, the optical elements each including a first portion, a second portion and a third portion arranged to direct the light across the first portion of the display surface, wherein the first lighting assembly is attached to the walkway and all of the LEDs of the first lighting assembly are mounted in a single assembly; and a second lighting assembly that includes a second plurality of LEDs and a second plurality of optical elements, the second plurality of LEDs being thermally coupled to a second heat sink, wherein the LEDs of the second plurality of LEDs are arranged in a plurality of rows, each row including a plurality of LEDs mounted so that all of the LEDs of the second lighting assembly are arranged in a common orientation, and wherein each optical element of the second plurality of optical elements is disposed over only one associated LED, the optical elements each including a first portion, a second portion and a third portion arranged to direct the light across the second portion of the display surface, wherein the second lighting assembly is attached to the walkway at a location laterally spaced from the first lighting assembly and all of the LEDs of the second lighting assembly are mounted in a single assembly, wherein the display surface can be illuminated using only the first lighting assembly and the second lighting assembly so that the visual media content can be viewed without additional light.</p>
<p>12. The billboard of claim 11, wherein the first lighting assembly is configured to uniformly illuminate the first area of the display surface, and wherein the second lighting assembly is configured to uniformly illuminate the second area of the display surface.</p>
<p>13. The billboard of claim 12, wherein each and every LED of the first lighting assembly is configured to uniformly illuminate the first area of the display surface, and wherein each and every LED of the second lighting assembly is configured to uniformly illuminate the second</p>

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area of the display surface.
<p>15. The billboard of claim 11, wherein the optical elements of the first lighting assembly each include a first portion, a second portion and a third portion arranged to direct the light across the first area of the display surface; and wherein the optical elements of the second lighting assembly each include a first portion, a second portion and a third portion arranged to direct the light across the second area of the display surface.</p>
<p>20. A billboard comprising: a support structure; a display surface mounted on the support structure, the display surface having a width of forty-eight feet along an upper edge and a lower edge of the display surface and a height of fourteen feet along a left side edge and a right side edge of the display surface, the display surface comprising a first portion extending from the lower edge to the upper edge adjacent the left side edge and a second portion extending from the lower edge to the upper edge adjacent the right side edge, the first and second portions together extending from the left side edge to the right side edge; a first lighting assembly including a first plurality of light emitting diodes (LEDs) arranged in a first row and a second row, the first lighting assembly also including a first plurality of optical elements arranged in the first row and the second row over the plurality of LEDs such that each optical element overlies only one associated LED, the optical elements each including a first portion, a second portion and a third portion arranged to direct light from the first plurality of LEDs across the first portion of the display surface; and a second lighting assembly including a second plurality of LEDs arranged in a first row and a second row, the second lighting assembly also including a second plurality of optical elements arranged in the first row and the second row over the second plurality of LEDs such that each optical element overlies only one associated LED, the optical elements each including a first portion, a second portion and a third portion arranged to direct light from the second plurality of LEDs across the second portion of the display surface; wherein the first lighting assembly is mounted at a first location, and wherein the second lighting assembly is mounted at a second location, wherein the first location is laterally spaced from the second location along the width of the display surface; and wherein the display surface of the billboard can be illuminated using only the first lighting assembly and the second lighting assembly so that visual media content on the display surface can be viewed without additional lighting.</p>
<p>22. The billboard of claim 20, wherein the optical elements of the first and the second lighting assemblies are arranged so that areas beyond edges of the display surface receive minimum illumination.</p>
<p>25. A method of illuminating a forty-eight by fourteen foot outdoor billboard using only two lighting assemblies, wherein the billboard comprises a display surface having visual media content displayed thereon, the visual media content comprising a picture and/or text, wherein the display surface has a width of forty-eight feet along an upper edge and a lower edge of the</p>

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display surface and a height of fourteen feet along a left side edge and a right side edge of the display surface, the display surface comprising a first area extending from the lower edge to the upper edge near the left side edge and a second area extending from the lower edge to the upper edge near the right side edge, the first and second areas together extending from the left side edge to the right side edge, the method comprising:

illuminating the first area of the display surface by emitting light from a first plurality of LEDs mounted in a common plane in a first assembly and redirecting the light across the first area using a first plurality of optical elements, **each optical element** being disposed over only one associated LED and **including a first portion, a second portion and a third portion** arranged to direct the light across the first area of the display surface so that the visual media content of the first area is visible without any additional light; and at the same time, illuminating the second area of the display surface by emitting light from a second plurality of LEDs mounted in a common plane in a second assembly and redirecting the light across the second area using a second plurality of optical elements, **each optical element** being disposed over only one associated LED and **including a first portion, a second portion and a third portion** arranged to direct the light across the second area of the display surface so that the visual media content of the second area is visible without any additional light.

28. The method of claim 25, wherein illuminating the first area and illuminating the second area comprises illuminating the first area and illuminating the second area so that areas beyond edges of the display surface receive **minimum illumination**.